EXP-11
May 31, 1972

ACCELERATOR EXPERIMENT--High Field Aperture

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Date Performed: May 27-28, 1972

Measurement

A more careful measurement of high field orbit at 70 GeV was made. The result shows a peak-to-peak radial orbit excursion of ~3.5 cm.

The orbit is then moved radially inward at ~80 GeV by the rf radial-position control. The beam can be moved ~3 cm inward at $x_{p\ max}$ without loss. No outward movement seemed to be possible.

Analysis

The full horizontal geometrical aperture at β_{max} and $x_{p\ max}$ is 4.9 in = 12.4 cm. Various contributions to occupying this aperture are

Closed orbit distortion (measured here)	3.5 cm
Momentum spread of beam assuming $\frac{\Delta p}{p} = \pm 10^{-3}$	1.0
Horizontal beam size (measured*)	1.0
Sagitta of bending magnet	0.6
Total	6.1 cm

*Measured using the ionization profile strip-probe. The full width covers about 2-1/2 strips each 1/8" wide. The probe is located at β_{probe} = 58 m. Scaled to the location of β_{max} = 98 m this gives

$$\left(2.5 \times \frac{1}{8}\right) \frac{\sqrt{98}}{\sqrt{58}} \text{ in} = 0.4 \text{ in} = 1.0 \text{ cm}.$$

This leaves 12.4-6.1 = 6.3 cm or about ±3 cm free aperture for the beam to move in and out. The above measurement shows that the beam can indeed be moved inward by 3 cm. If the beam could also be moved outward without loss by 3 cm using the rf radial-position control we would have accounted for the design radial aperture.

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